

# 2011 Military Health System Conference

## Emerging Science in TBI Care: Diagnosis and Treatment

The Quadruple Aim: Learning & Growth, Readiness, Experience  
of Care

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# Agenda: Emerging Science and DoD Programs



- DoD Definition of TBI
- Severity of Injury
- Continuum of Care
  - Prevention
  - Surveillance
  - Screening/Assessment
  - Diagnosis
  - Case Management
  - Treatment
  - Rehabilitation
  - Reintegration
- The Way Ahead





# DoD TBI Definition (Oct 07)

- Traumatically induced structural injury or physiological disruption of brain function as a result of external force to the head
- New or worsening of at least one of the following clinical signs
  - Loss of consciousness or decreased consciousness
  - Loss of memory immediately before or after injury
  - Alteration in mental status (confused, disoriented, slow thinking)
  - Neurological deficits
  - Intracranial lesion
- DoD definition parallels standard medical definition
  - CDC, WHO, AAN, ACRM





# Severity Rating for TBI

## Traumatic Brain Injury

Severity	GCS	AOC	LOC	PTA
Mild	13-15	≤24 hrs	0-30 min	≤24 hrs
Moderate	9-12	>24 hrs	>30min <24 hrs	>24hrs <7 days
Severe	3-8	>24hrs	≥24 hrs	≥7 days

**GCS** - Glasgow Coma Score

**AOC** - Alteration of  
consciousness

**LOC** - Loss of consciousness

**PTA** - Post-traumatic amnesia

2011 MHS Conference



# TBI Clinical Standards: Severity, Stages, Environment



## **Types of TBI**

Mild

Moderate

Severe

Penetrating

## **TBI Post-Injury Stages**

Acute

Sub-Acute

Chronic

## **Levels of TBI Care**

In-theater

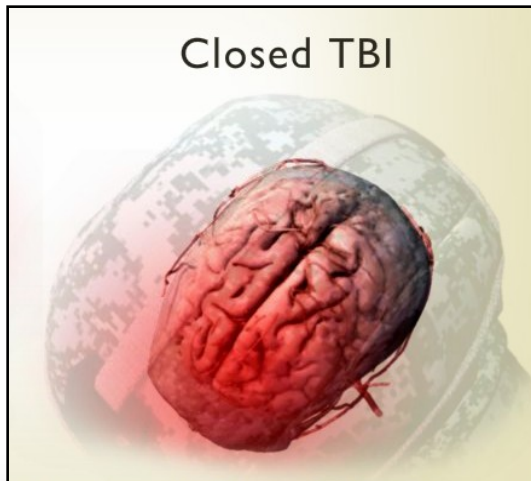
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In-patient

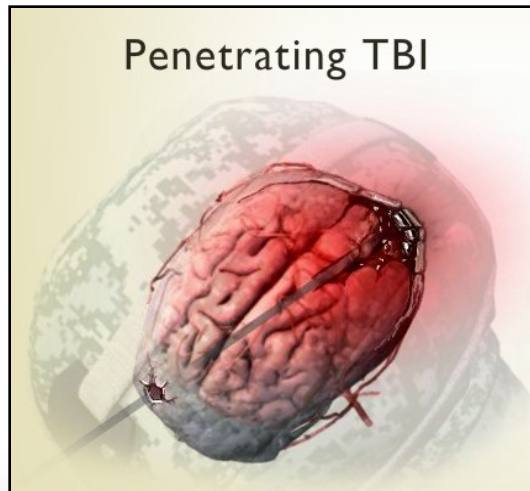
Outpatient

Community

Closed TBI



Penetrating TBI







# Possible Effects of mTBI

- Acute
  - Poor marksmanship
  - Slower reaction time
  - Decreased concentration
- Chronic
  - Reduced work quality
  - Behavioral problems
  - Emotional problems
  - “Unexplained”

TBI-related impairments increase vulnerability to subsequent injury until full recovery occurs





# TBI Milestones

- **AUG 03:** Walter Reed Army Medical Center
  - MANDATORY TBI screening for all medically evacuated personnel, regardless of injury or illness
- **SUMMER 05:** Wilford Hall Medical Center
  - MANDATORY TBI screening of all medically evacuated personnel
- **MAY 06:** Landstuhl Regional Medical Center
  - MANDATORY TBI screening for all medically evacuated personnel, regardless of injury or illness
- **AUG 06:** Deployment of the Military Acute Concussion Evaluation (MACE) tool
- **JAN 07:** In-Theater Clinical Practice Guidelines (Version 1.0)
- **APR 07:** VA Facilities
  - MANDATORY TBI screening
- **JAN 08:** Post-deployment Health Assessment & Reassessment (PDHA & PDHRA)
  - Addition of TBI screening questions
- **APR 09:** VA/DoD/DCoE Evidence Based guidelines for mild TBI
  - Cognitive rehabilitation consensus conference and clinical guidance package developed
- **MAY 09:** Pre-deployment Requirements
  - Mandatory cognitive baselines on SMs (NCAT/ANAM)
- **JUN 10:** DCoE initiated Directive Type Memorandum (DTM) #09-033

**Numerous screening safety nets to ensure capture of SMs requiring intervention**



# What are Our Major Challenges?



- **Undetected TBI**
  - Screening/Detection (pre-, intra-, post-deployment)
  - Directive Type Memorandum (DTM)
- **Force Readiness/Cultural Barriers**
  - Line education
  - Partnering with the NFL
- **Improving Collaborations with VA, Academia and Civilian Organizations**
- **Deployment Related Assessments**
  - Neurocognitive Issues after Concussion – e.g. Testing after event or deployment
- **Effective treatments**
  - Repeat Concussions
  - Co-Morbidities
- **Research**
  - “Fast tracking” for objective markers diagnostic of





# Continuum of Care







# Prevention

- Head-borne system
  - Improve protection from ballistic threats
  - Reduce injury from blast events
- Use of seat belts/ PPE
- Sports related injuries
  - Helmets
- Public awareness campaigns aimed at educational and prevention strategies
  - CDC: Head's UP





# Continuum of Care







# US Military TBI Diagnoses

TBI Diagnoses (all severities) 2000-2010 Q3											
2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010Q3	TOTAL
10,963	11,830	12,470	12,898	13,312	12,192	16,946	23,160	28,555	29,223	23,998	195,547

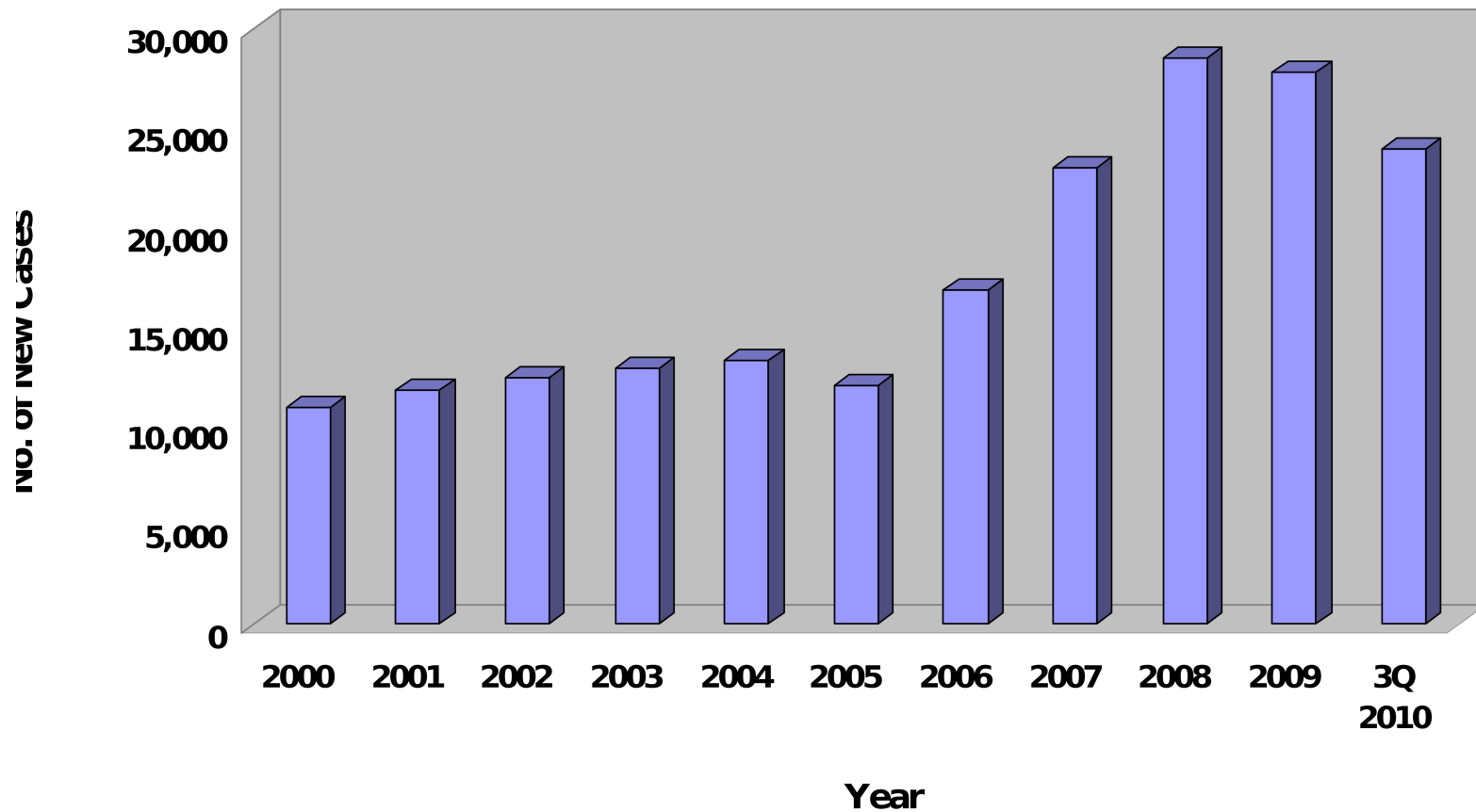
- SOURCE: <http://www.dvbic.org/TBI-Numbers.aspx>
- Compiled using electronic medical records - represent actual medical diagnoses of TBI in the US Military



# How Big is the TBI Challenge?



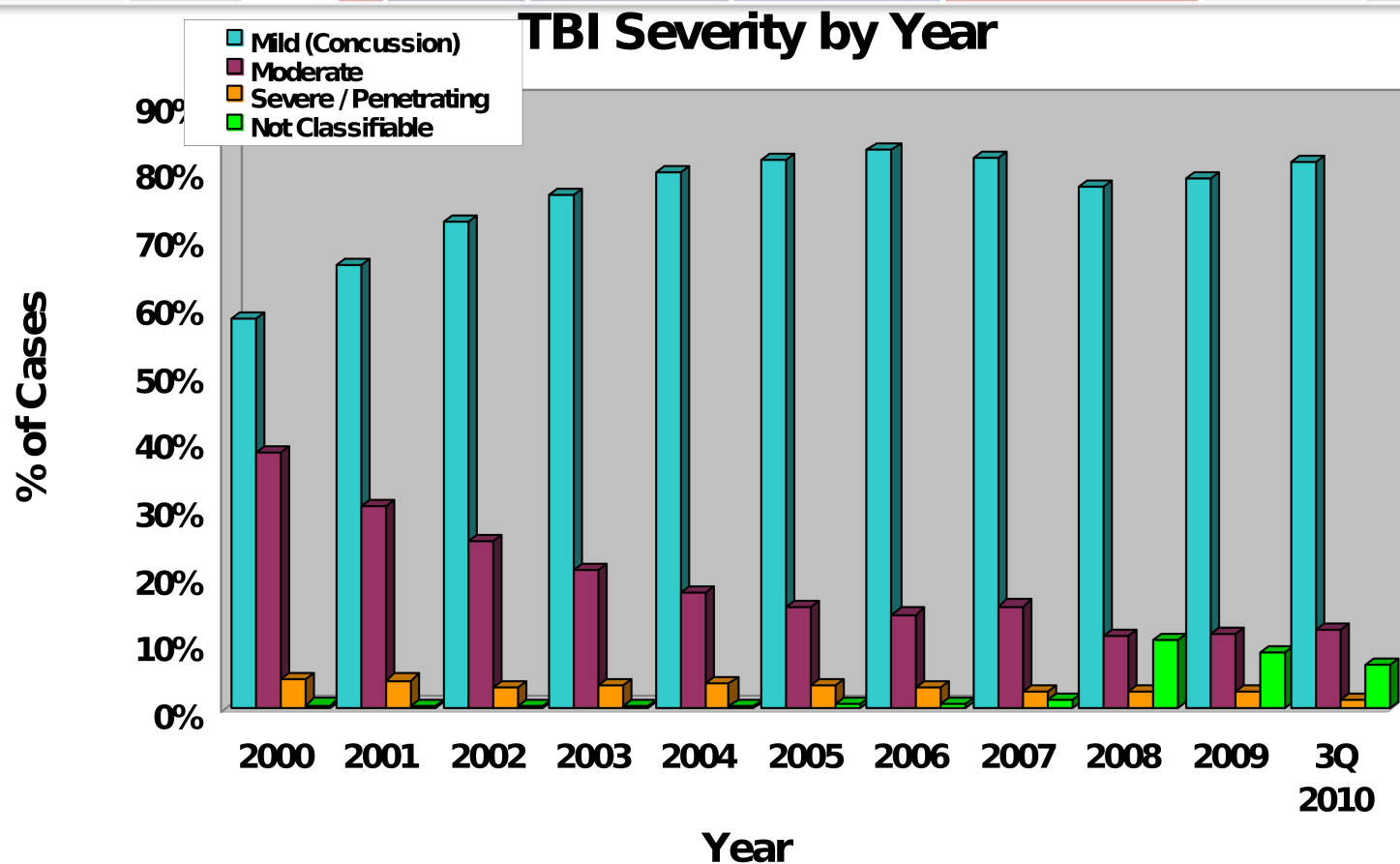
## Number of TBI Cases First Identified by Year



Data Source: [www.DVBIC.org](http://www.DVBIC.org)



# Tracking the Impact: TBI Severity Data



Original Data Source: [www.DVBIC.org](http://www.DVBIC.org)





# Continuum of Care





# Policy Guidance for the Management of Concussion/mTBI in the Deployed Setting



- Directive-Type Memorandum (DTM) 09-033
- Issued 21 June 2010 by DEPSECDEF
- Involves commitment of line commanders and medical community
  - DCoE coordination with FHP/R, JS, CENTCOM, JTAPIC, Service TBI POC's
- Describes mandatory processes for identifying those service members involved in potentially concussive events
  - Exposed to blast, vehicle collision, witnessed loss of consciousness, other head trauma
- DCoE developed specific protocols for management of concussed Service members and those with recurrent concussion
- Transition from symptom driven reporting to incident driven

**DESIRED END STATE: the mitigation of the effects of potential concussive events on both Service member health, readiness and ongoing operations**





# ighlights from the DTM

- Mandatory **event driven protocols**, for exposure to potentially concussive events
- Requires a medical **evaluation and a rest** period
- All sports and **activities with risk** of concussion are prohibited **until medically cleared**
- Military Acute Concussion Evaluation (MACE) documentation will include **MACE 3-part score**
- Service Members diagnosed with mTBI will be given a **standardized educational**



# TBI Management Continuum

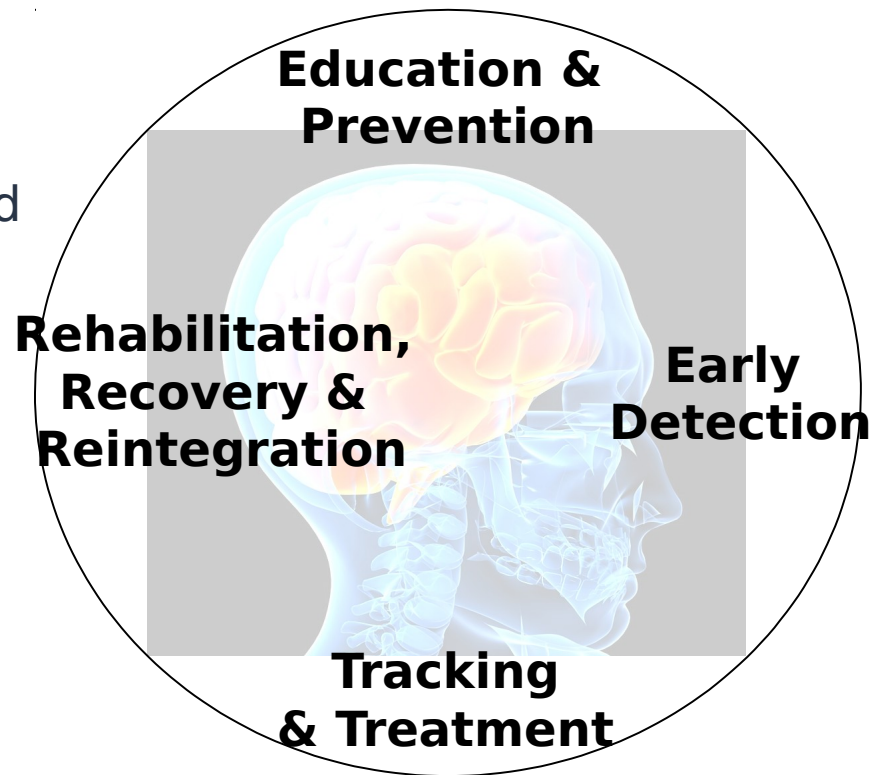


- **GOAL:** A *cultural change* in Warfighter management after concussive events: identification and documentation of the incident, treatment close to point of injury, and expectation of recovery with early treatment.

▪ **VISION:** Every Warfighter trained to:

- Recognize the signs/symptoms
- Equipped to reduce the effects
- And in the event of an injury –*
- Treated early to minimize the impact and maximize recovery from TBI.

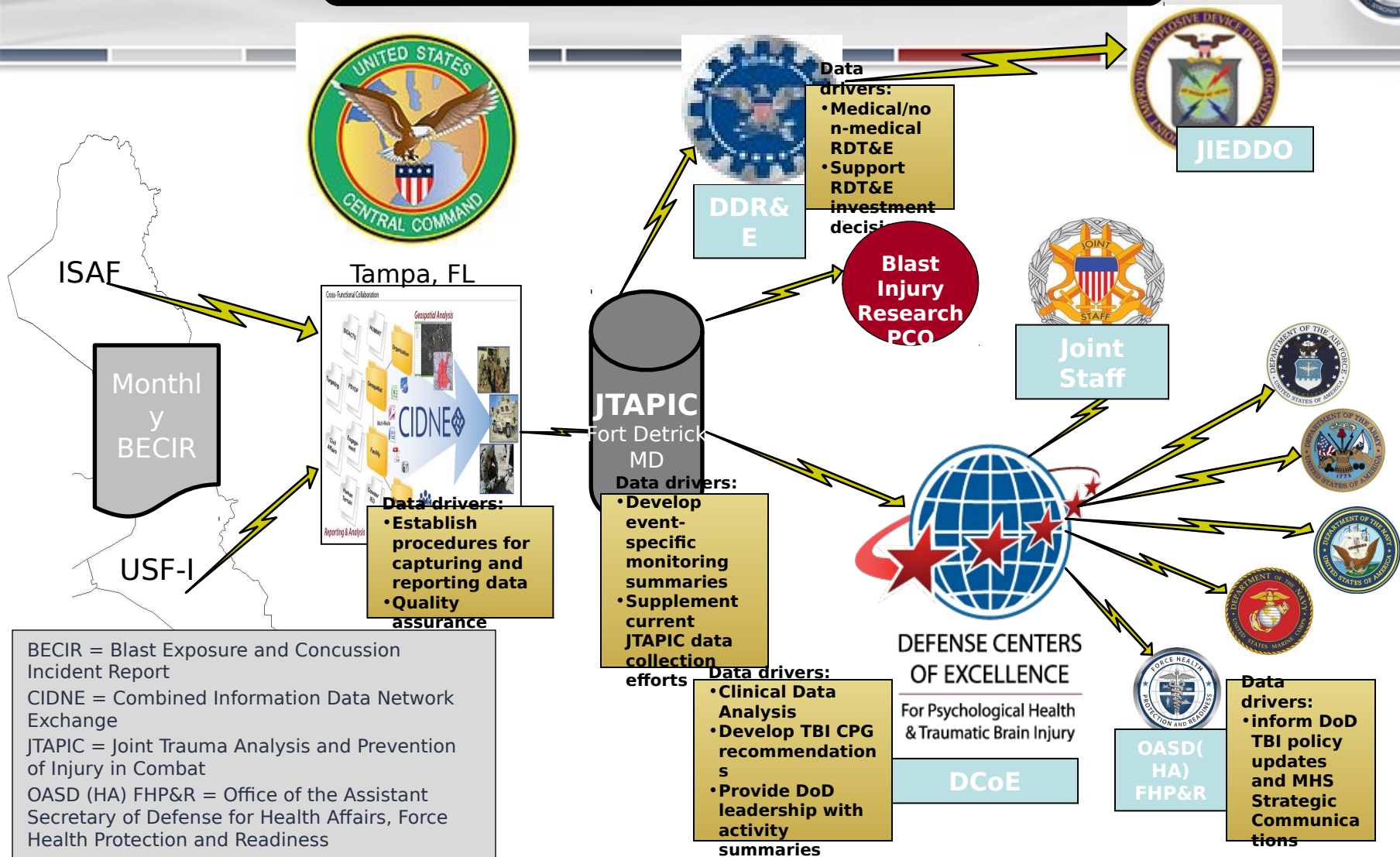
- **MISSION:** Produce an educated force trained and prepared to provide early recognition, tracking, treatment & documentation of TBI in order to



**Educate - Train - Track - Treat**



# MTBI DTM Data Flow




BECIR = Blast Exposure and Concussion Incident Report  
 CIDNE = Combined Information Data Network Exchange  
 JTAPIC = Joint Trauma Analysis and Prevention of Injury in Combat  
 OASD (HA) FHP&R = Office of the Assistant Secretary of Defense for Health Affairs, Force Health Protection and Readiness  
 DDR&E = Director, Defense Research & Engineering  
 JIEDDO = Joint Improvised Explosive Device Defeat Organization  
 BIR PCO = Blast Injury Research Program Coordinating Office



# MACE: Military Acute Concussion Evaluation



 **Military Acute Concussion Evaluation (MACE)**  
Defense and Veterans Brain Injury Center

Patient Name: \_\_\_\_\_  
SS#: \_\_\_\_\_ Unit: \_\_\_\_\_  
Date of Injury: \_\_\_\_/\_\_\_\_/\_\_\_\_ Time of Injury: \_\_\_\_\_  
Examiner: \_\_\_\_\_  
Date of Evaluation: \_\_\_\_/\_\_\_\_/\_\_\_\_ Time of Evaluation: \_\_\_\_\_

**History: (I – VIII)**

I. **Description of Incident**  
Ask:  
a) What happened?  
b) Tell me what you remember.  
c) Were you dazed, confused, “saw stars”? ☐ Yes ☐ No  
d) Did you hit your head? ☐ Yes ☐ No

II. **Cause of Injury** (Circle all that apply):  
1) Explosion/Blast 4) Fragment  
2) Blunt object 5) Fall  
3) Motor Vehicle Crash 6) Gunshot wound  
7) Other \_\_\_\_\_

III. **Was a helmet worn?** ☐ Yes ☐ No Type \_\_\_\_\_

IV. **Amnesia Before:** Are there any events just BEFORE the injury that are not remembered? (Assess for continuous memory prior to injury)  
☐ Yes ☐ No If yes, how long \_\_\_\_\_

V. **Amnesia After:** Are there any events just AFTER the injuries that are not remembered? (Assess time until continuous memory after the injury)  
☐ Yes ☐ No If yes, how long \_\_\_\_\_

VI. **Does the individual report loss of consciousness or “blacking out”?** ☐ Yes ☐ No If yes, how long \_\_\_\_\_

VII. **Did anyone observe a period of loss of consciousness or unresponsiveness?** ☐ Yes ☐ No If yes, how long \_\_\_\_\_

VIII. **Symptoms** (circle all that apply)  
1) Headache 2) Dizziness  
3) Memory Problems 4) Balance problems  
5) Nausea/Vomiting 6) Difficulty Concentrating  
7) Irritability 8) Visual Disturbances  
9) Ringing in the ears 10) Other \_\_\_\_\_

08/2006 DVBIC.org 800-870-9244  
This form may be copied for clinical use.  
Page 1 of 6

- Developed by DVBIC and released in Aug 2006
- Performed by medical personnel
- 3-Part Screening Tool – “CNS”

- Cognition
- Neurological Exam
- Symptoms

- Alternate versions available
- Upcoming revision will include recurrent concussion questions
- Can be used during exertional testing to ensure





# Post Concussive Symptoms

## Physical

- Headache
- Dizziness
- Balance Problems
- Nausea/vomiting
- Fatigue
- Visual disturbances
- Sensitivity to light/noise
- Ringing in the ears

## Emotional

- Anxiety
- Depression
- Irritability
- Mood lability

## Cognitive

- Slowed processing
- Decreased attention
- Poor concentration
- Memory problems
- Verbal dysfluency
- Word-finding
- Abstract reasoning



# Assessment/ Reassessment (January 08)



9.a. During this deployment, did you experience any of the following events? **(Mark all that apply)**

- (1) **Blast or explosion (IED, RPG, land mine, grenade, etc.)**
- (2) **Vehicular accident/crash (any vehicle, including aircraft)**
- (3) **Fragment wound or bullet wound above your shoulders**
- (4) **Fall**
- (5) **Other event (for example, a sports injury to your head). Describe:**

9.b. Did any of the following happen to you, or were you told happened to you, IMMEDIATELY after any of the event(s) you just noted in question 9.a.? **(Mark all that apply)**

- (1) **Lost consciousness or got “knocked out”**
- (2) **Felt dazed, confused, or “saw stars”**
- (3) **Didn’t remember the event**
- (4) **Had a concussion**
- (5) **Had a head injury**

9.c. Did any of the following problems begin or get worse after the event(s) you noted in question 9.a.? **(Mark all that apply)**

- (1) **Memory problems or lapses**
- (2) **Balance problems or dizziness**
- (3) **Ringing in the ears**
- (4) **Sensitivity to bright light**
- (5) **Irritability**
- (6) **Headaches**
- (7) **Sleep problems**

9.d. In the past week, have you had any of the symptoms you indicated in 9.c.? **(Mark all that apply)**

- (1) **Memory problems or lapses**
- (2) **Balance problems or dizziness**
- (3) **Ringing in the ears**
- (4) **Sensitivity to bright light**
- (5) **Irritability**
- (6) **Headaches**
- (7) **Sleep problems**

**Positive screen = concurrence to all four questions**

**Positive screen  $\neq$  concussion diagnosis**

**Need clinician confirmation to diagnose concussion**



# Neurocognitive Assessment Tool (NCAT)/Automated Neuropsychological Assessment Metrics (ANAM)



- Computerized neurocognitive assessment tool
- Purpose:
  - Establish an accurate assessment of pre-injury cognitive performance for comparison in post-injury return to duty (RTD) decisions
    - One piece of clinical picture
    - Selective use for those with more clinically challenging cases
- Takes 20 minutes to complete
- Current policy (May 08):
  - All pre-deployers receive baseline cognitive testing with ANAM within one year of deployment
  - Over 758K SM's baselined through 31 Dec 2010
- Other tools being studied head-to-head (H2H)
- Better assessment if injured SM is compared to their baseline scores as opposed to a normative





# Continuum of Care







## Objective Markers of Concussion

of concussion:

(not limited to):

### *Objective Test for Post Concussion Syndrome*

- **Pupillary response/visual tracking (*EYE-TRAC: Eye-Tracking Device*)**
- **Biomarkers - serum, saliva, skin (BANDITS: Biomarker Assessment for Neurotrauma Diagnosis & Improved Triage System)**
- **Imaging - Diffusion Tensor Imaging (DTI) (Blast related TBI using DTI)**
- **Electrophysiologic parameters- qEEG, event related potentials, heart rate (Hand Held Real time multichannel EEG : Brainscope Ahead M-100)**





# Continuum of Care





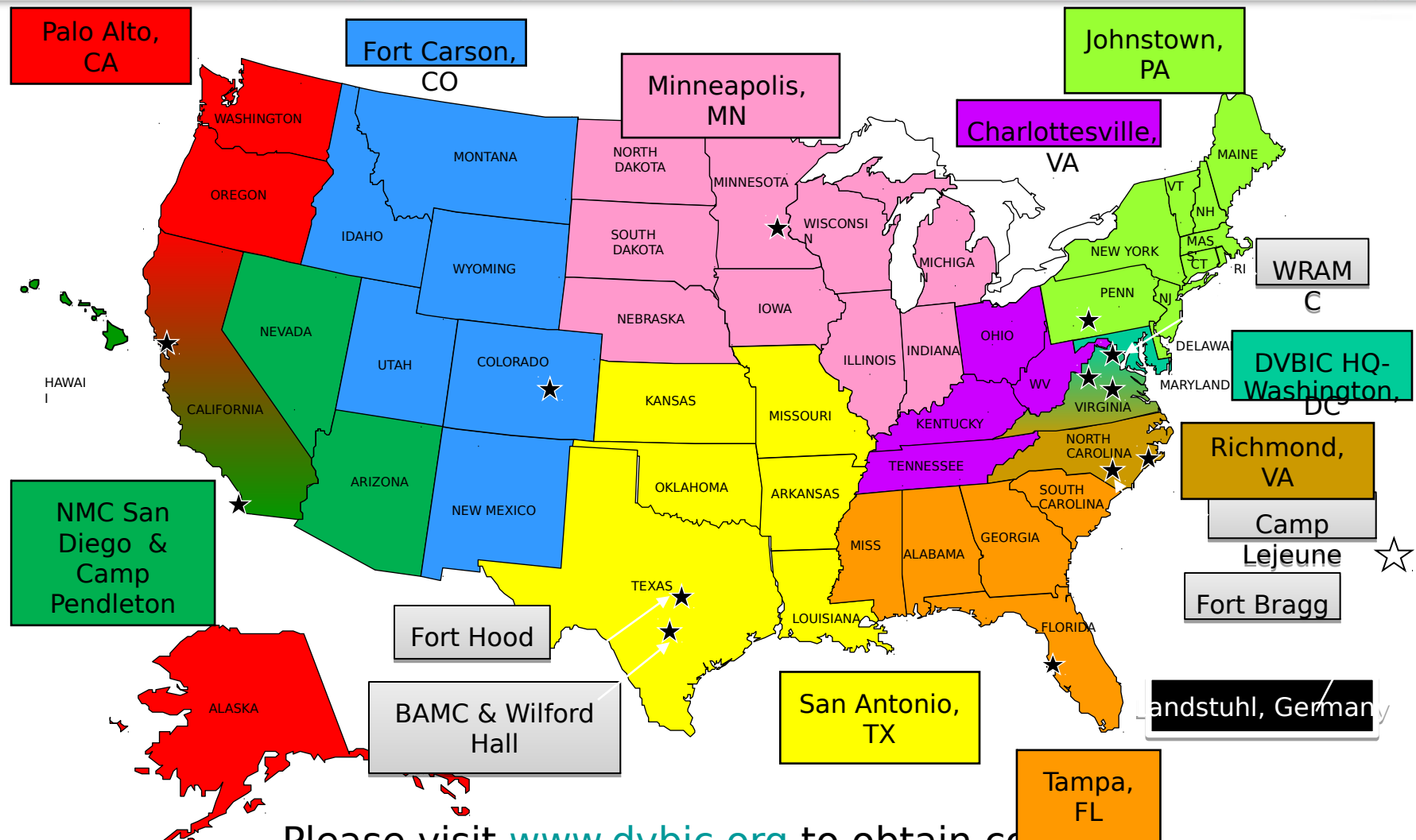
# TBI Case Management Initiatives



- TBI CM SOP: get this at [www.dcoe.health.mil](http://www.dcoe.health.mil)
- TBI Community of interest newsletter
- DVBIC Regional Care Coordination program
- Coordination with Federal Recovery Coordination program



# DVBIC Regional Education and Care Coordination Areas



Please visit [www.dvbic.org](http://www.dvbic.org) to obtain contact information for your regional education or care coordinator.





# Continuum of Care





# What's New in Treatment of TBI?



- **Clinical Practice Guidelines**

- TBI clinical practice guidelines and clinical support tools profiles and analysis
- Cognitive Rehabilitation in TBI
- Management of Severe TBI treatment literature review
- Altitude effects on TBI literature review
- Sleep and TBI literature review
- Neuroendocrine sequelae of TBI literature review
- Toolkit for Treating mTBI and Co-Occurring Conditions

- **Rehabilitation / Recovery / Reintegration**

- DVBIC - Virtual TBI Clinic (VTC)
- National Intrepid Center of Excellence (NICOE)

- **Dissemination to the field**

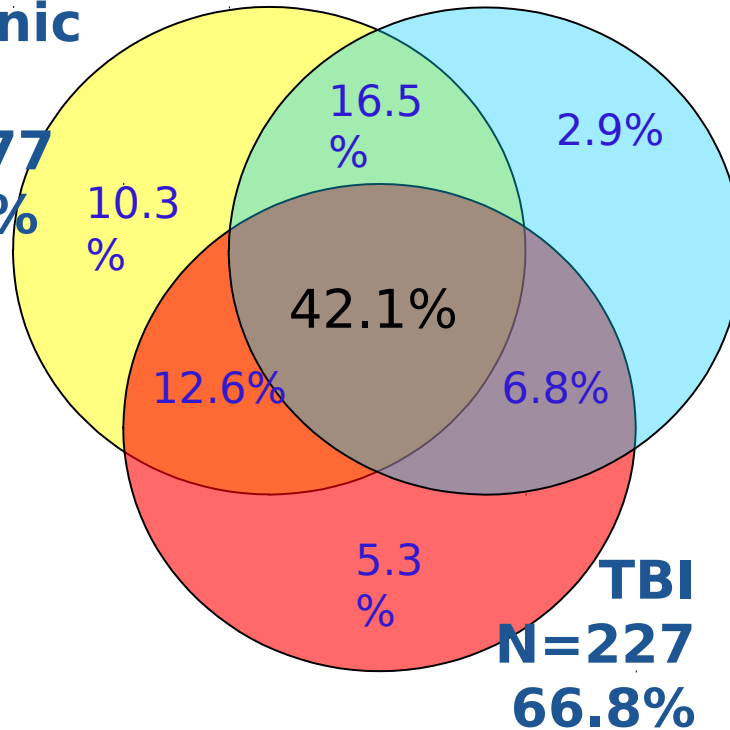


# Co-Morbidities Associated with mTBI



**Chronic Pain**

**N=277**  
**81.5%**



**PTSD**  
**N=232**  
**68.2%**

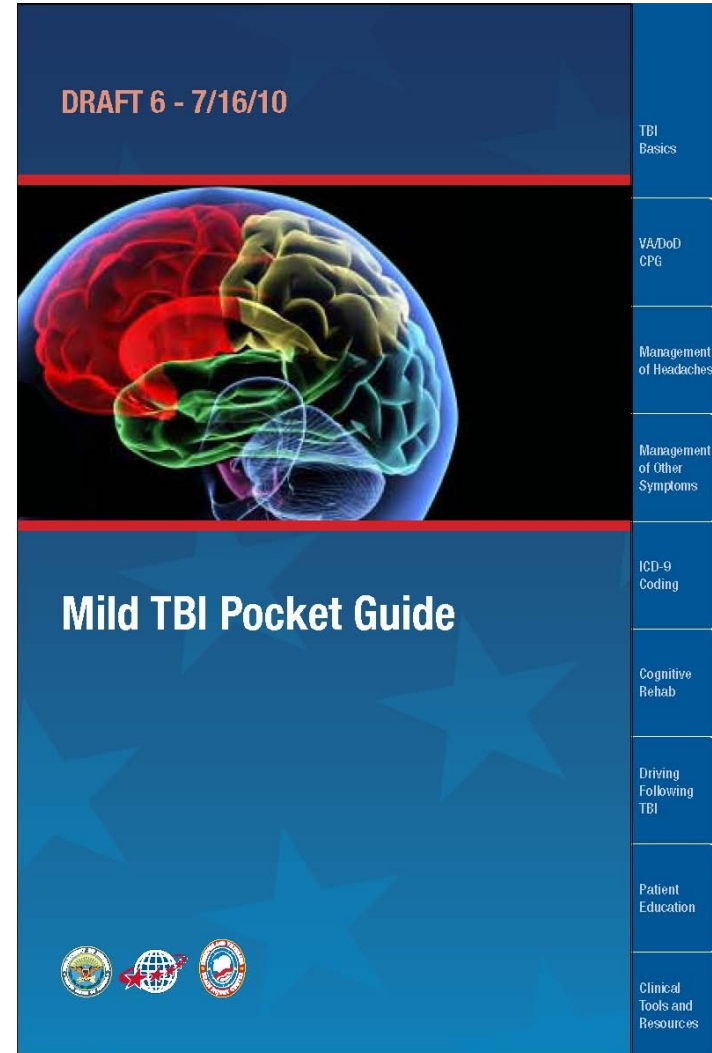
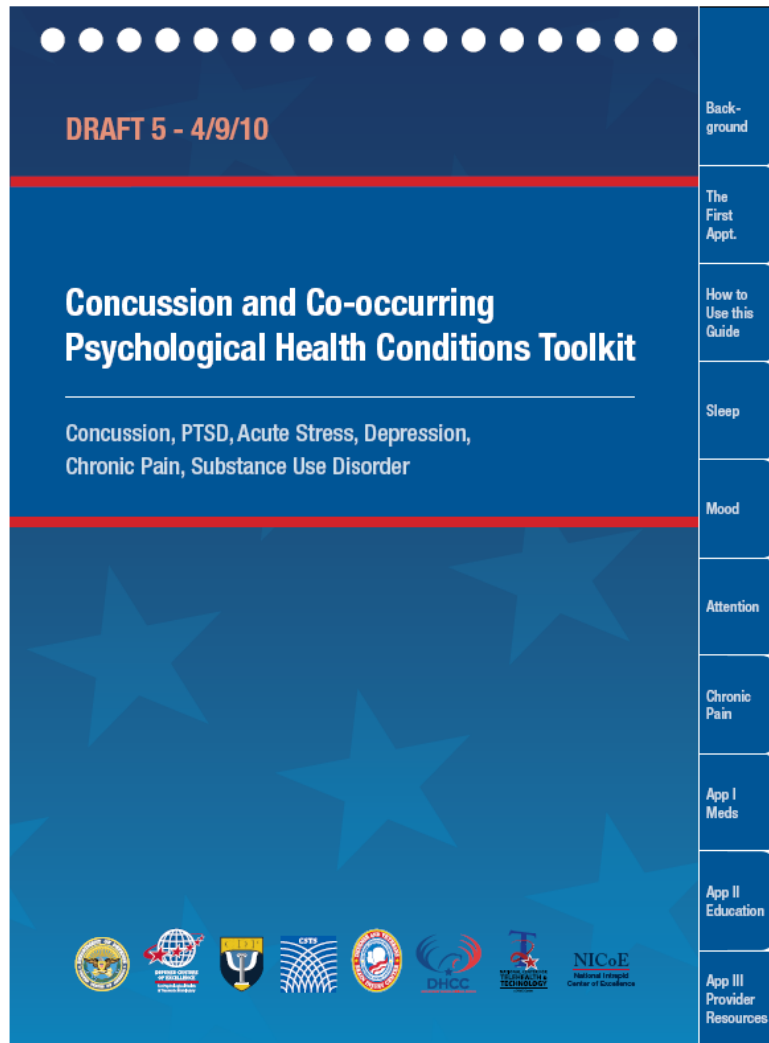
- Sleep disorders
- Substance abuse
- Psychiatric illness
- Vestibular disorders
- Visual disorders
- Cognitive disorders

Lew, et al: "Prevalence of Chronic Pain, Posttraumatic Stress Disorder, and Persistent Postconcussive Symptoms in OIF/OEF Veterans: Polytrauma Clinical Triad", Dept. of Veterans Affairs, Journal of Rehabilitative Research and Development, Vol. 46, No. 6, 2009, pp. 697-702, Fig. 1





# Toolkit and Pocket Guide





# Sample Treatments Undergoing Scientific Inquiry



- List not exhaustive
- Hyperbaric Oxygen
- Cognitive Rehabilitation
  - SCORE trial
- Neuroprotection Drugs
  - Docosahexaenoic acid (DHA)
  - Progesterone
  - NNZ – 2566
  - Growth Hormone





# Continuum of Care





# Treatment: Cognitive Rehabilitation



## ▪ Cognitive domains affected after TBI

- Attention
  - Foundation for other cognitive functions/goal-directed behavior
  - Efficacy of attention training established
- Memory
  - True memory impairment vs. poor memory performance from inattention
  - Evidence to support development of memory strategies and training in use of assistive devices ('memory prosthetics')
- Social/Emotional
  - Evidence to support group sessions in conjunction with individual goal setting
- Executive Function
  - Evidence to support training use of multiple step strategies, strategic thinking and/or multitasking

## ▪ Compensatory vs. restorative therapy



# Cognitive Rehabilitation for Mild TBI: Demonstration Project - April 2010



- Implementation at 13 MTFs
- Subsequent discussion with the Services resulted in modification of the 13 to the following: Ft. Bragg, WRAMC, Redstone Arsenal, Ft. Campbell, Ft. Gordon, BAMC, Ft. Stewart, Ft. Riley, Wilford Hall, Elmendorf, Camp Pendleton, Portsmouth, Camp Lejeune, and San Diego. (Out: Ft. Hood and 29 Palms) (In: Ft. Stewart, San Diego)
- Beginning in Aug 2010, each MTF will track outcome measures identified in the Clinical Guidance Document

- Report back to the CPSC in



HEALTH AFFAIRS

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE  
WASHINGTON, DC 20301-1200

APR 14 2010

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (M&RA)  
ASSISTANT SECRETARY OF THE NAVY (M&RA)  
ASSISTANT SECRETARY OF THE AIR FORCE (M&RA)

SUBJECT: Guidance for Implementation of the Cognitive Rehabilitation for Mild Traumatic Brain Injury Clinical Guidance Document at Select Military Treatment Facilities

Mild traumatic brain injury (mTBI), also known as concussion, is a significant health concern for the Department of Defense (DoD) as it is one of the common injuries sustained on the battlefield. The majority of individuals with mild TBI have symptoms that are transient and self-limiting with apparent full recovery occurring within minutes to several weeks following injury, but a small number do not show the expected rapid and uneventful recovery and have persistent symptoms and/or functional limitations. Cognitive rehabilitation has been identified as an intervention for individuals with persistent symptoms and/or functional limitations following mTBI.

On September 9, 2009, the Clinical Proponency Steering Committee (CPSC) approved implementation of the attached clinical guidance document, "Cognitive Rehabilitation for Mild Traumatic Brain Injury," at appropriate Military Treatment Facilities (MTFs). This memorandum directs that the clinical guidance document be implemented at the following MTFs identified by their TBI Service representatives as having an ongoing cognitive rehabilitation program or the capabilities for such a program: Ft. Bragg; Walter Reed Army Medical Center; Redstone Arsenal; Ft. Campbell; Ft. Gordon; Brooke Army Medical Center; Ft. Hood; Ft. Riley; Wilford Hall Medical Center; Elmendorf Air Force Base; Camp Pendleton; Twentynine Palms; Naval Medical Center Portsmouth; and Camp Lejeune.

Beginning in the 2010 calendar year, each of these MTFs will track the outcome measures identified in the clinical guidance document, to include at least one performance metric focusing on pre- and post-functional differences, and submit these to their TBI Service representatives. Our staff will work with the TBI Service representatives to collect all sites' outcome measures so that a report can be provided to the CPSC by September 30, 2010. Measures of effectiveness of outcomes will be assessed and presented to the CPSC to determine if implementation of this clinical guidance document is warranted at additional MTFs. While this guidance is only applicable to these MTFs, the cognitive rehabilitation guidance document also may be implemented at other sites upon request.



# Cognitive Rehabilitation Research Efforts



- NDAA FY 10: RCT for cognitive rehab in TBI in returning OEF/OIF
- DVBIC SCORE trial: 4 arms, San Antonio. Set to begin in March 2011
- CDMRP BAA for studies: Final proposal review. Awards pending
- IOM study: evaluate certain interventions in cognitive rehabilitation for efficacy. Report due by October 2011





# Continuum of Care







# Resources

- National Resource Library
- Military OneSource
- DCoE 24/7 Outreach Call Center
- [www.dvbic.org](http://www.dvbic.org)
- TBI Family Caregiver Guide
- [www.Afterdeployment.org](http://www.Afterdeployment.org)
- DCoE Facebook, Twitter, YouTube, Scribd
- Multiple Mobile Smartphone Applications
- DCoE Blog
- Yellow Ribbon Presentations
- Handbook for Family & Friends of Service Members Before, During, and After Deployment



# IOM Study of Readjustment Needs of SM's, Veterans and their Families (in progress)



- Phase I Recommendation
- “The committee recommends that the Department of Defense and the Department of Veterans Affairs oversee coordination and communication of the multitude of programs that have been created in response to the needs of Operation Enduring Freedom and Operation Iraqi Freedom service members, veterans, and their family members in an effort to maximize their reach and effectiveness. The committee also recommends that there be independent evaluation of these programs with standardized evaluation designs and assessment of outcomes.”



# Cumulative Concussion and Longitudinal Effects

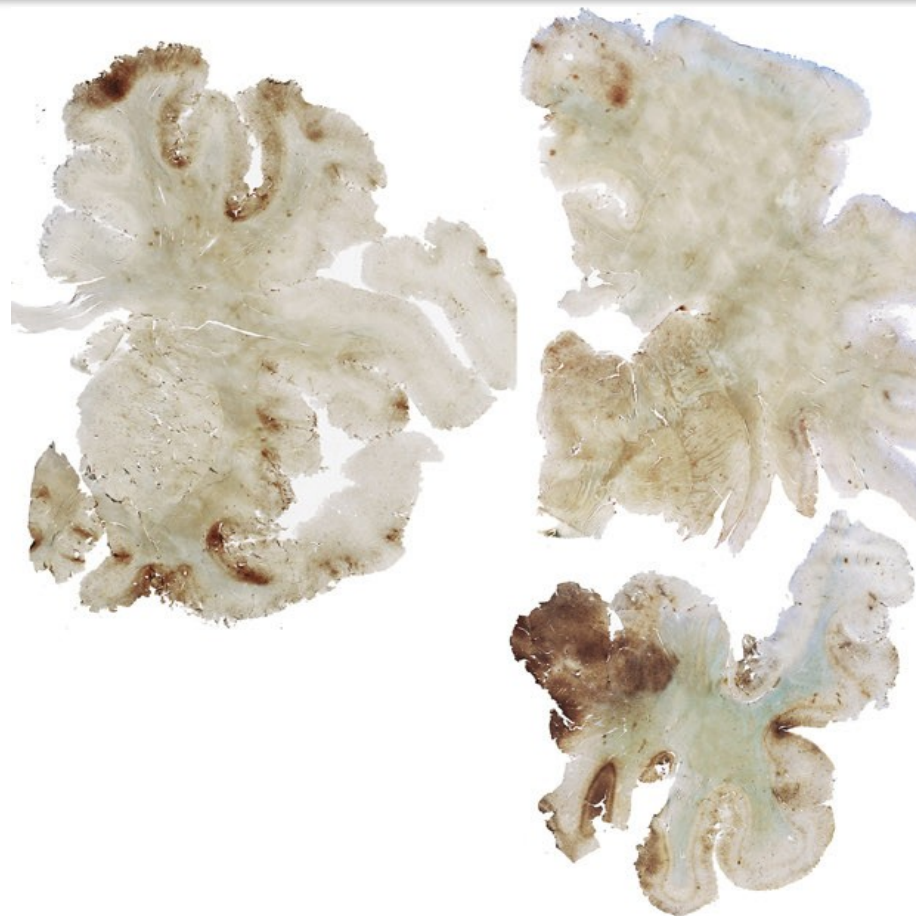


- Congressionally mandated 15 year longitudinal study (DVBIC executing)
- Brain banks
- Addition of MACE question on initial evaluation about cumulative concussion and DTM data
  - Follow Electronic Health Record through system and VA



# Chronic Traumatic Encephalopathy

- Chronic Traumatic Encephalopathy
- Symptoms can Include:
  - Memory disturbances
  - Behavioral changes
  - Personality changes
  - Parkinsonism
  - Speech abnormalities

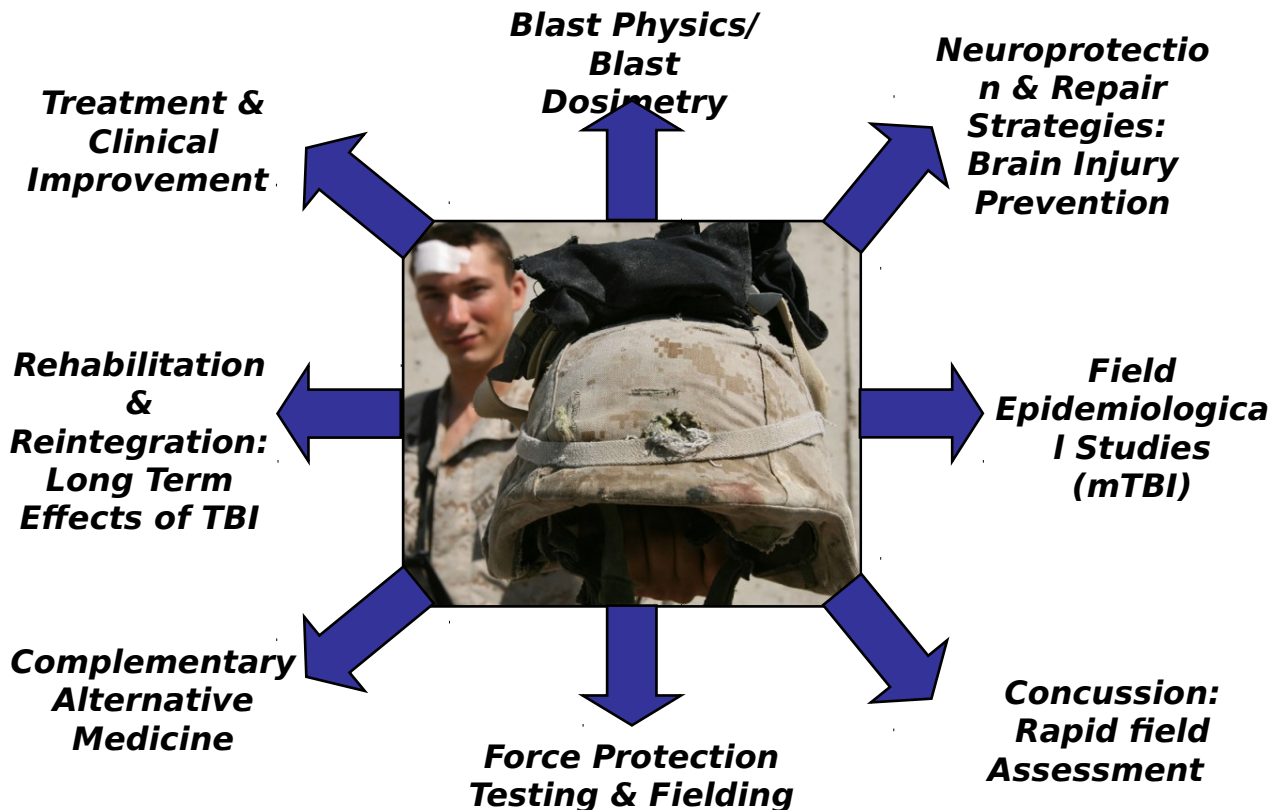


Coronal sections immunostained for tau with monoclonal antibody AT8 and counterstained with cresyl violet

*McKee AC, Cantu RC, Nowinski CJ, et al, J Neuropathol Exp Neurol Volume 68, Number 7, July 2009*



# DoD TBI Research Initiatives



- **Close collaboration among the line, medical, and research communities**
- **Key areas**
  - Rapid field assessment of concussion (i.e., rapid eye movement tracking, biomarkers)
  - Novel therapeutics (i.e, omega-3, progesterone, **Hyperbaric Oxygen trials**, cognitive rehabilitation)
  - Blast dynamics (i.e., neuroimaging)



# National Intrepid Center of Excellence (NICoE)



- Located on NNMC campus in Bethesda, MD
- Dedicated 24 June 2010
- Serves SM (and their families!) with complex TBI and PH care needs
- Primarily evaluative in nature
  - Generally to be used by those who have refractory or difficult-to-diagnose/manage conditions
  - Provides case management and referral capabilities to leading experts in the field
- Initial Operating Capability: Oct 10
- Full Operating Capability: Oct 11







# TBI Way Forward

## Detection & Screening

- Complete revisions of PDHA and PDHRA forms (to be finalized Jan 2011). DCoE review of TBI and PH portions.
- Neurocognitive Assessments: Continue pre-deployment neurocognitive testing and post-event testing where appropriate
- Develop rapid and effective screening tools for field use

## Cultural

- **Transformation** service members
- Target TBI education to Combatant Commanders and leaders, bringing responsibility from medical into line
- Continue to encourage data sharing between DoD and VA

## Treatment/Rehabilitation

- Continue training every provider treating TBI patients (Service coordination and leveraging)
- Develop provider education compliance metrics and evaluate the Services' and MTF efforts to improve TBI care





# TBI Way Forward (continued)

## Treatment /Rehabilitation (cont'd.)

- TBI Programs to validate TBI protocols and procedures used by Military Health System (MHS)

## Research

- Continue fast-track of promising TBI research
- Translate promising research into practice in an expedited fashion when a threshold of scientific rigor has been met to safely institute
- Neurocognitive Assessments: Complete head-to-head study of cognitive testing tools; explore potential defining of post-deployment normative cognitive scores
- Continue work with the VA and other public/private organizations to yield collaborations and products benefitting TBI care



# TBI Way Forward (continued)



## **Information Technology**

- implement web-based baseline NCAT data system – anticipated to begin field testing second quarter FY 11
- Increase IT infrastructure to support improved EHR communication across agencies and allows patient tracking
- Enterprise-wide solutions that allow for capture of medical data from point of injury through reintegration (to include VA)



# Questions and Answers

